Thermal Equilibration Near the Liquid-Vapor Critical Point of ^{3}He

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A NASA funded "Microgravity Scaling Theory Experiment" will measure specific heat and isothermal susceptibility near the liquid-vapor critical point of ^{3}He. A good understanding of the equilibration process for various measurements in a microgravity environment is essential because of the limited time available in space. To reduce the equilibration time, we have designed a cylindrical cell containing a stack of plates that separate the bulk fluid into 60 equally thin layers. To understand the thermal behavior of the whole cell, we analyzed the thermal behavior of a 2D composite system of a near-critical fluid layer in contact with a copper plate. In this 2D analysis, one side boundary consisting of both the fluid layer and copper plate experiences either pulse heating or a step temperature change. The other three boundaries are adiabatic. The solution of this 2D composite system includes the piston effect that speeds up the equilibration and the viscous effect that weakens the piston effect close to the liquid-vapor critical point. The numerical simulation indicates that the characteristic length for the equilibration of the stacked cell is determined by an effective thickness of a single fluid layer instead of the total height of the cylindrical cell. The results of this 2D study of the composite system will be presented.